# Navigation Economic Technologies NETS

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*University of Oregon*
*and*
*Institute for Water Resources*

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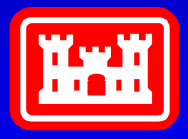


# Waterway Investments

- Army Corps of Engineers manage and help to develop the nation's waterways and ports.
- Investments are considered to:
  - Rehab/Replace Locks and Dams
  - Widen and deepen channels
  - Provide moorings and turning basins,

# Investments

- Investment Expenditures:
  - Require authorization by Congress and the President
  - Proposed plans are reviewed by the stakeholders, the Corps and others.
  - Plans are typically based on some form of economic analysis of the benefits and costs.

# Impetus for NETS

High visibility USACE planning studies:

- Delaware Canal
  Forecast assumptions
  Model not computationally correct

- Upper Mississippi (National Research Council and Others)
  1. Forecast not based on model, but on a single expert.
  2. Model structure and model inputs "elasticity"
  3. Non-structural options

# Agency & Public Comments

## Reactions to NAS Review

- Corps of Engineers Reform Act

  "...increase the *transparency* of Corps decision making process..."

  *Senator Feingold*

- "Too many Corps projects are based on *questionable economic* and environmental studies. Project *benefits are exaggerated* while costs are underestimated..."

  *Scott Faber, Environmental Defense Fund*

# Agency & Public Comments

## Myers/Greenup Interim

- "…the Sierra Club has significant concerns related to the *economic justification* of the proposed project."

  *- Sierra Club*

- "…the need to pursue *nonstructural options*… should not be peremptorily dismissed without full consideration…"

  *-Environmental Protection Agency*

- Scope of CEA needs to be broadened – *system versus site specific*

  *- EPA & USFWS*

# NETS Goals:

- The goal of NETS is to advance the Corps world-class engineering with state-of-the art tools and techniques for economic modeling and analysis.

# NETS Philosophy

## Transparency / Glass Box

IWR has adopted a “glass-box” software design philosophy. The goal is to have an independently peer reviewed computational kernel and through the use of a graphical user interface (GUI) allow stakeholders to “see” the data, simulation and results.

# Teaming

- NETS research focused on teaming with academic it first 1 ½ years.
- Now NETS is highly coordinated with the Planning Centers of Expertise for Inland and Deep Draft Navigation.

  Wes Walker – Huntington

  Ken Claseman – Mobile
- We have researchers from 7 Universities, Contractors, CX personnel, HQ and ASA personnel to assist IWR with this task.

# Activities

1. Theory
2. Estimation of shipper response
   Elasticity of demand with respect to system attributes.
3. Traffic Modeling
   Traffic forecasting models
   Regional routing model
   Microscopic models
4. Externalities
5. Economics of Deep Draft Vessels
6. Event studies, appointment systems and tradable permits
7. Peer Review
8. Communications

# Theory

The primary objective of the research is to develop an equilibrium model (theoretical) that will capture the effects of geographically dispersed suppliers and demanders of different commodities that share or could share the nation's inland waterway system under alternative assumptions about the nature of competition in the industry.

- Dr. Simon Anderson – University of Virginia
- Dr. Wesley Wilson – University of Oregon

# Theory

Spatial Equilibrium Models to:

- Examine competitive equilibrium in transport markets with
  1. Spatially Dispersed Demand
  2. Railroads, Truck and Barge
  3. Locks and Congestion
- Railroad Pricing, Capacity and Alternative Markets
- Welfare Measurement and full spatial equilibrium versus Fixed Region Models and ORNIM
- Spatial Competition and Market Power: Cournot, Bertrand and Networks

# Revealed Choice and Stated Preference Choice Models

The NETS team is using stated preference and revealed choice techniques to shape the “shipper response function”.  The idea is to attempt this on several waterways for several commodity groups.

# Estimating Shipper Response

A series of surveys are being conducted to estimate response to changes in waterway attributes. The survey technique combines stated preference and revealed choice techniques to shape the "shipper response function" (demand curve). These include congestion, reliability, rates and travel time.

Four surveys have been completed.

- Modeling Preferences for Upper Mississippi Grain Movements: The Mid-American Grain Study
- Transportation Demand in the Columbia-Snake River Basin
- Upper Mississippi Grain
- Upper Mississippi Non-Grain

Additional study in progress for the Ohio River System.

# Mid-America Grain Study

- Professor Kenneth Train of the University of California at Berkeley and Professor Wesley W. Wilson of the University of Oregon and the Institute for Water Resources form the study team.
- A survey of grain shippers was conducted to obtain information about the mode and origin/destination (O/D) of their shipments, the next-best alternative mode and O/D, as well as factors that might induce the shipper to switch to the next-best alternative.
- An econometric model was estimated on the combined revealed-preference data (the shippers' observed choices in the market) and stated-preference data (the choices that shippers said they would make if transportation costs or times rose for their current mode and O/D.)

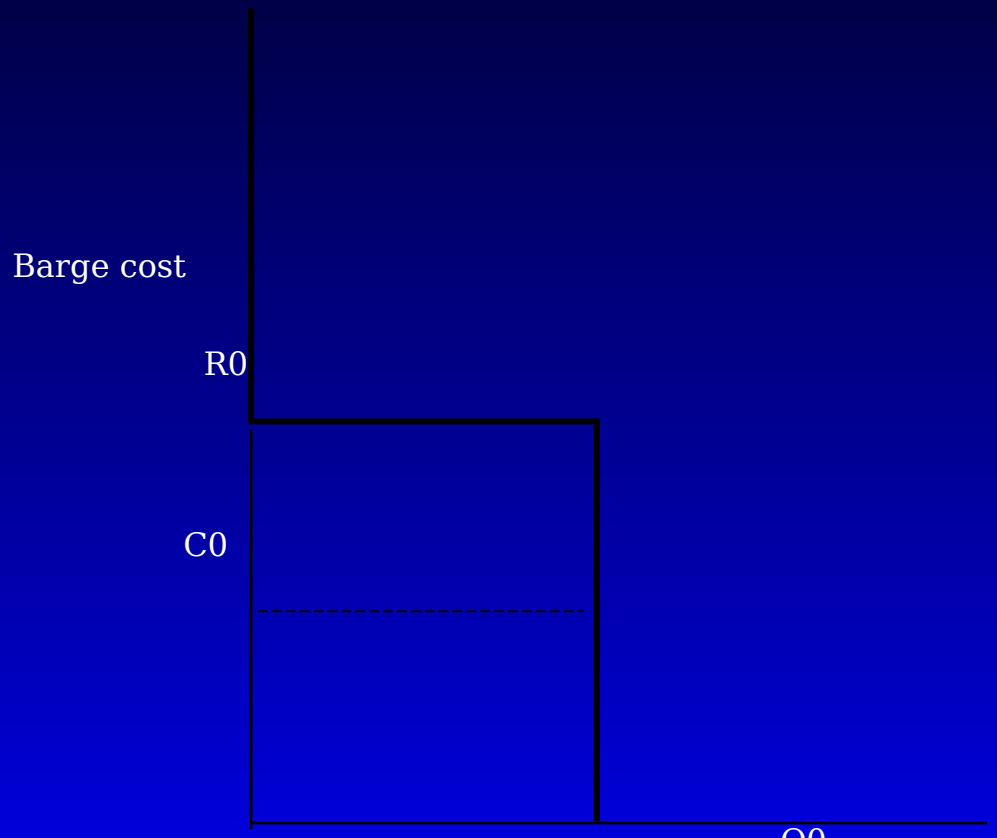
# Mid-America Grain Study

This study demonstrated several things.

- The most important being that it is possible (though difficult) to collect the necessary information to estimate shipper response.
- Also, the study confirms the shortcoming of traditional methods. Specifically that the reservation price (alternative rail price) understates the willingness to pay and that perfectly inelastic demand overstates willingness to pay. The net result of these two offsetting affects is unknown.

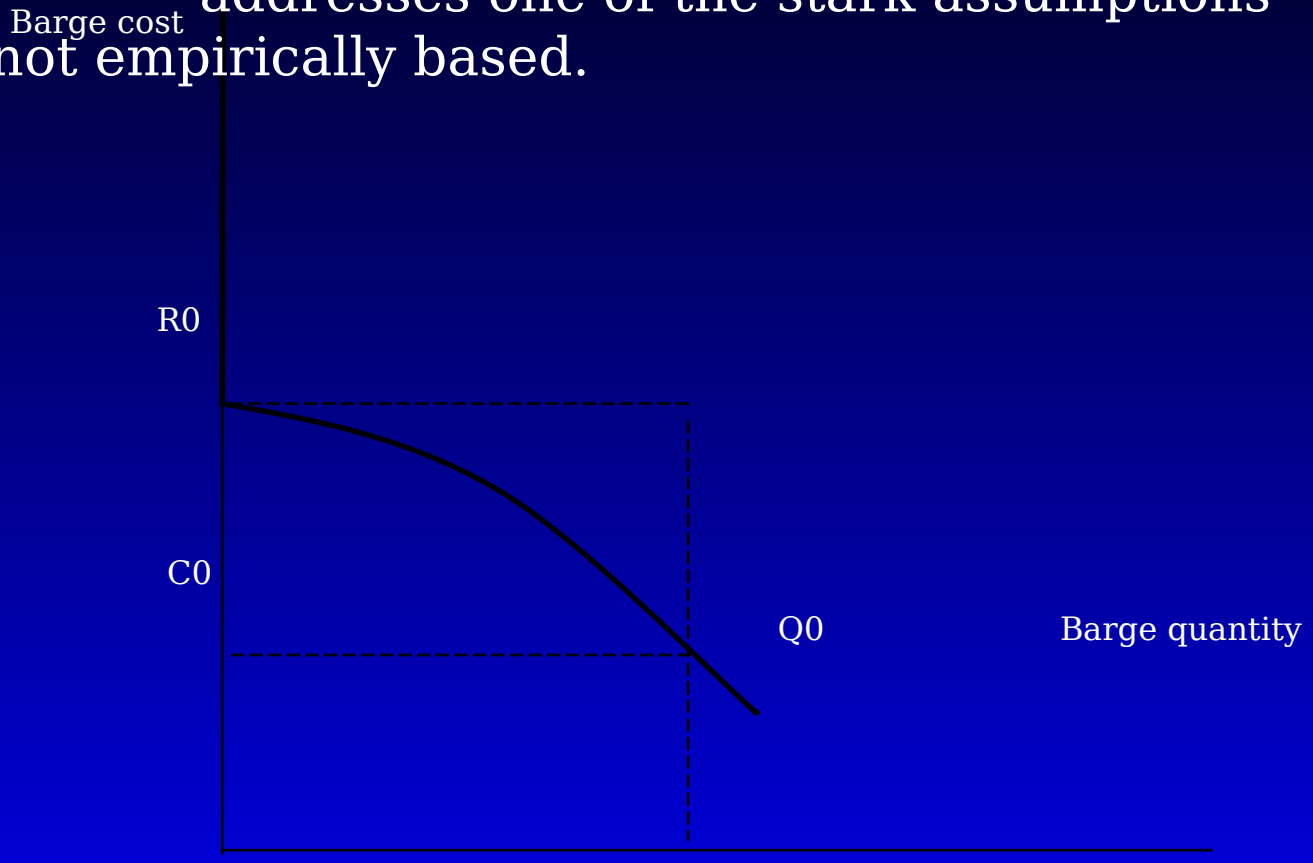
# ODC Triplicate Demand Curve Shaped as Inelastic

-Two Stark assumptions

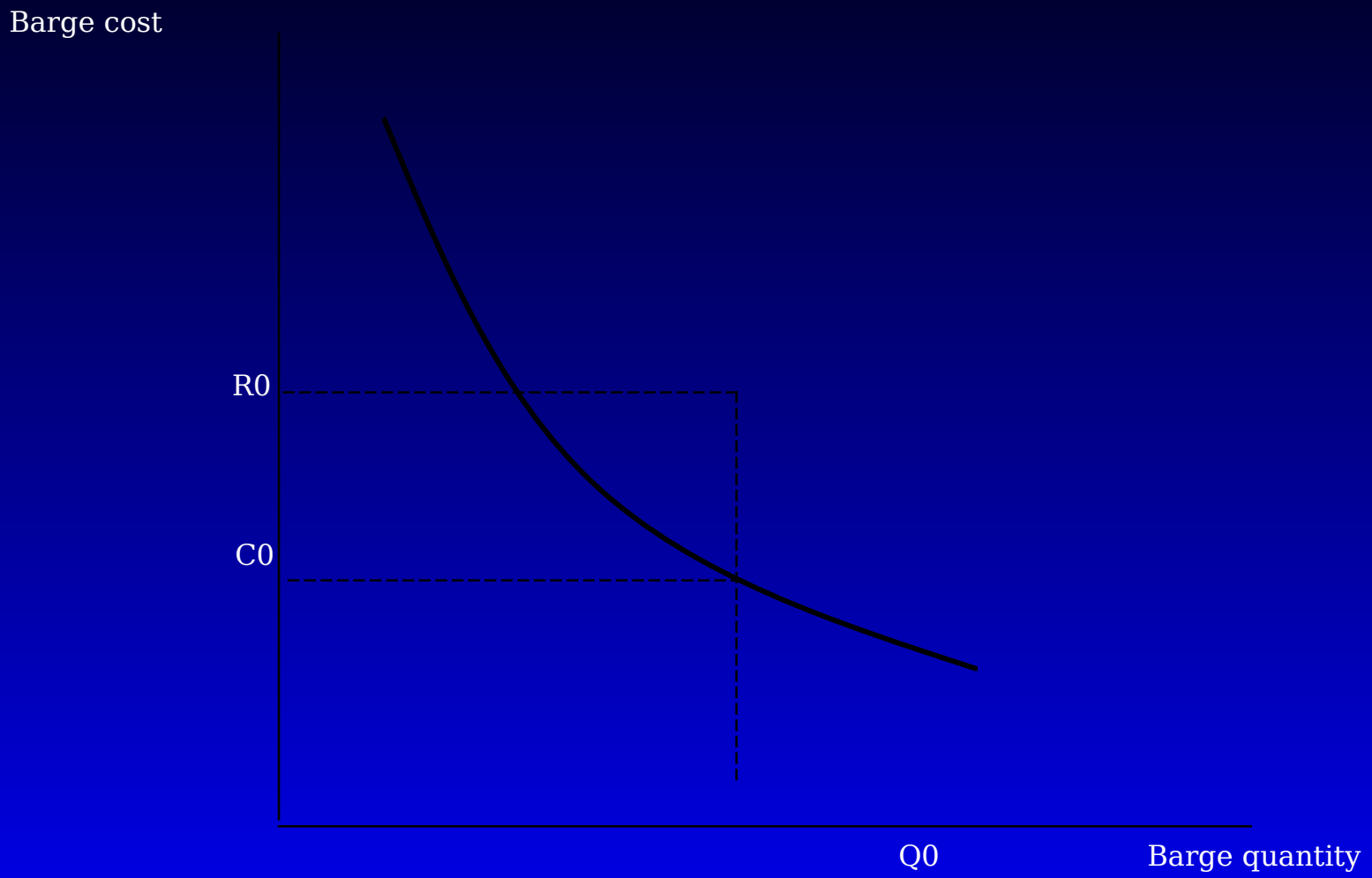


# Demand curve shaped by Essence

-addresses one of the stark assumptions – but not empirically based.



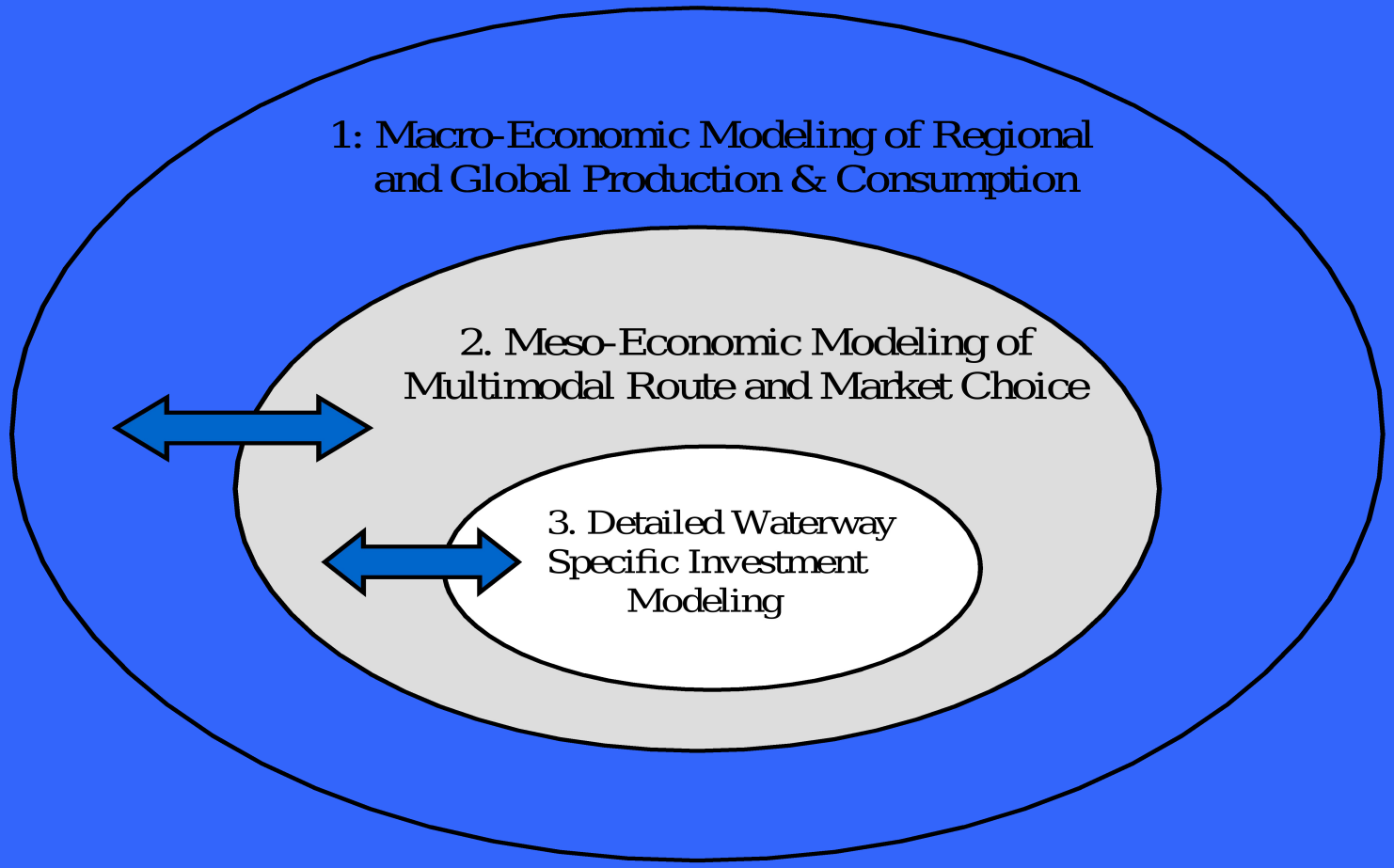
# Demand curve as shaped by Survey Model



# Other Survey Work

- Upper Miss Grain & Non-Grain
- Ohio River Goal & Non-Coal

# Three-Tiered Modeling


1: Macro-Economic Modeling of Regional and Global Production & Consumption
2. Meso-Economic Modeling of Multimodal Route and Market Choice
3. Detailed Waterway Specific Investment Modeling

= feedback between levels

# Modeling - Forecasting

The forecasting of commodity movements into the future can be dominate factor in estimating benefits of navigation improvements. The NETS research team is developing state of the art techniques for commodity forecasting. These techniques combine spatial equilibrium modeling, risk and uncertainty and scenario analysis.

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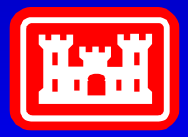
# Modeling -World Grain Model

The purpose of this study is to develop a spatial equilibrium model to forecast international commodity flows from a specific region. The methodology will be generally applicable to a broad range of commodities or regions, but the focus will be on the world grain trade and expected market responses to evolving competitive pressures and structural changes.

Dr. William Wilson – North Dakota State University



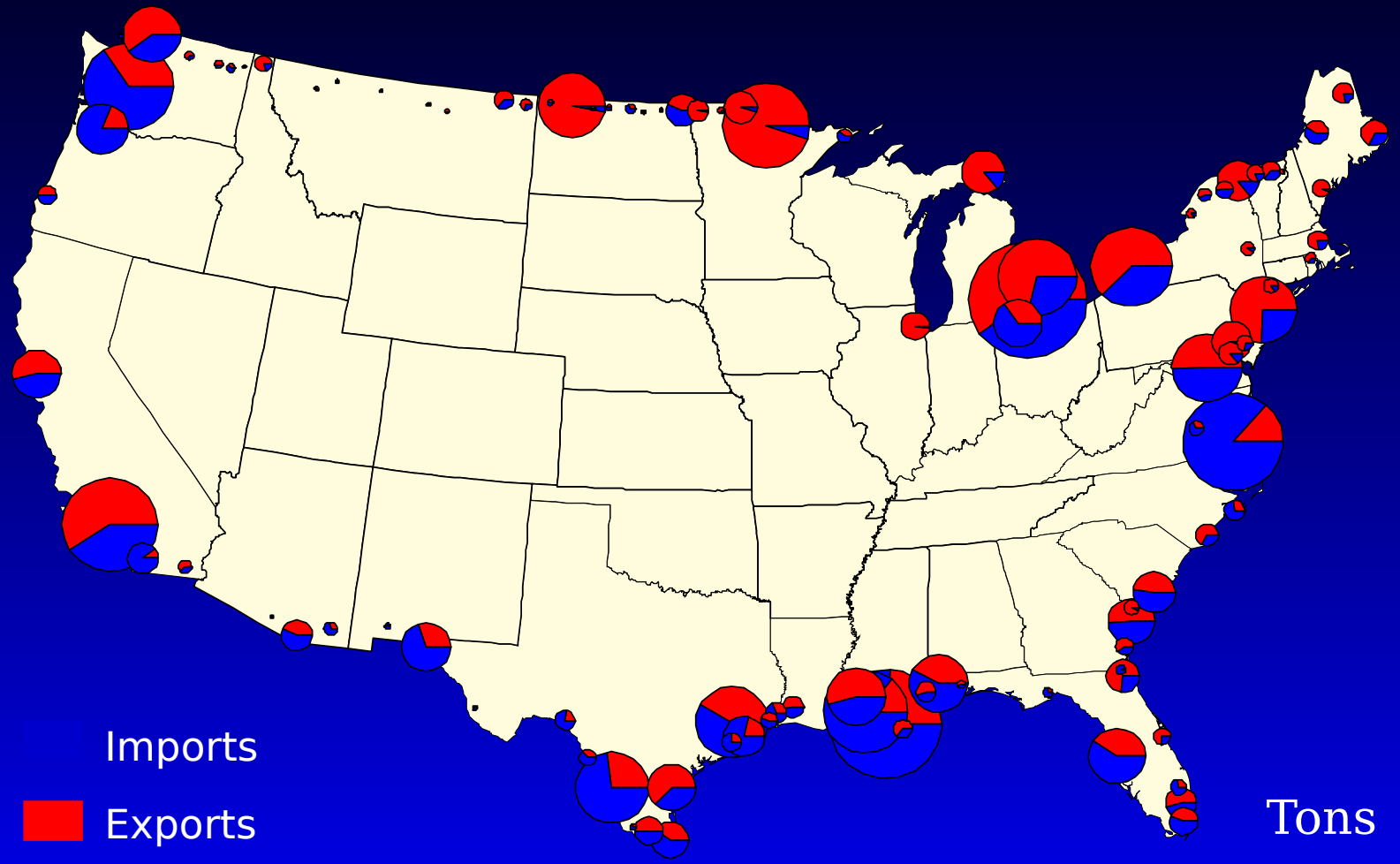
# Other Commodity Groups

- Using grain as the “proof of concept” model. This technique will be applied to other commodity groups. Commodity groups to be examined next:
    1. Petroleum
    2. Coal

# Modeling - Regional Routing Model

- The aggregate flows from the Global SEM forecasting model will assigned specific routes and modes.
- This will allow the project specific estimate of future traffic.
- Also, the affects to congestion and emission on the overland modes will be possible with this model.

# Top Gateways for International Trade for Truck, Rail and Water

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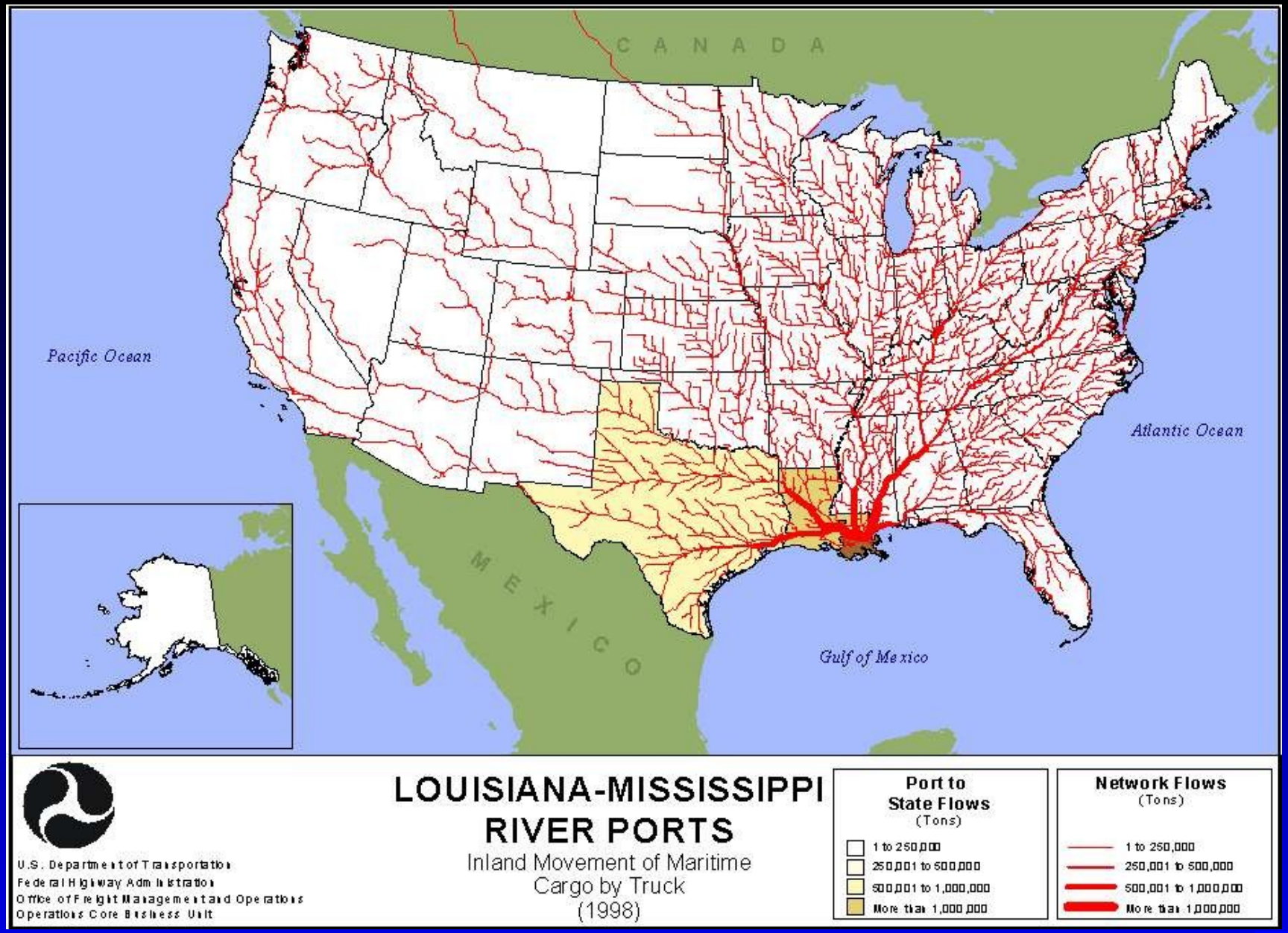


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# Microscopic Systems Model

Evaluation of:

- Tradable locking permits
- Scheduling – Appointment system
- Congestion pricing
- Lockage efficiency measures
- Locking policies
- Structural changes that increase capacity.

# Microscopic Systems Model

HarborSym – HarborSym is a simulation model that allows planners to analyze the economic impact of channel-widening projects. HarborSym calculates transit times and transportation costs by predicting vessel interactions based on user-provided vessel trip data and harbor transit rule information. Unproductive wait times result when vessels are forced to delay sailing due to transit rules and the movement of other ships within the system. HarborSym captures these delays. Using the model, analysts can calculate changes in transportation costs that will result from proposed modifications of the physical dimensions of the channel. After the widening version of HarborSym is fielded, a version will be developed to calculate the benefits of deepen a channel.

# Microscopic Systems Model

Navigation System Simulation Model (NaSS) The central focus of this project is to design and build a discrete-event multi-lock simulation model that generates and moves vessels through a network of waterways and locks, with incorporation of scheduled and unscheduled outages and associated shipper response.

Design Document is currently being updated to respond to independent peer review.

# NaSS Basin Model

- Heart of the NaSS
- Monte Carlo simulation model
- Generates and moves tows and other vessel types through a geo-located system of locks, ports and river reaches.
- Performance statistics are gathered as the simulation progresses.
- Currently at the end of prototype development
- Animation and other stages of development will be undertaken in FY07.

# Externalities

- Output from the Regional Routing Model will be used to estimate energy required to move the cargo, by mode and region. These energy estimates will be used to create emission profiles by region.
- As alternative improvements are evaluated, how they shift traffic and change the emission profile will be estimated.
- It would be possible to design a system to minimize emissions, in total or by region.

# Economics of Deep Draft Vessels

- Ian Mathis – Cost shared with other programs
  - Container/Cargo Carriage Life-Cycle Costing Evaluation
  - Vessel Fleet Forecast Methodology Unit
  - Vessel Load Factor Analysis
  - Vessel Motion in Confined Waterways/ Enhancements to ERDC-WES Channel Analysis and Design Evaluation Tool (CADET)

# EVENT STUDIES

- Forensic Economic analysis of an event.
- Coordinated and being executed by the LRD Cx for Inland Navigation.
    - Greenup closure
    - McAlpine L&D
    - L&D 27

# Tradable Permits

1. Investigating the use of market mechanism to increase the efficiency of the waterway.
   - Dr. Joe Cook – NERA
   - Dr. Charles Plott – Cal Tech

# Appointment System

1. NETS is teaming with UMSL-CTS to investigate the potential effectiveness

# Container Flow Model

The purpose of this study is to document changes in shipping patterns, both internationally and domestically, and to determine appropriate models for evaluating the impacts on these changes on infrastructure requirements. More specifically, the study will: 1) review previous studies on container shipping with a focus on infrastructure and projections; 2) describe historical movements in world trade; 3)describe and analyze historical movements in US markets as well as the rail market and ocean shipping economies; and 4) review and critique alternative models that can be used to analyze flows, restrictions, expansion possibilities and make projections. In addition, alternatives for handling and quantifying risk will be identified.

# Other Studies

- Spatially Generated Transport Demands
- Stated Response Models for Transportation Demand
- Lock, Vessel and Tow Boat Company Efficiency
- Port Choice
- Port Efficiency
- Port Efficiency and Trade
- Short-Run Non-Structural Forecasting
- Long-Run Co-Integrated Waterway Traffic and Forecasting
- Forecasting Waterborne Traffic from Lock Performance Data

# Independent Peer Review

- An independent peer review process has been established and is being followed for critical research.
  - A list of experts is maintained by the contractor. This list is by area of expertise.
  - When a study is to be reviewed, IWR submits the product and identifies the areas of expertise needed to evaluate the effort.
  - The contract randomly selects from the list and contracts for review. The contractor manages the review.
  - Comments are then submitted anonymously from the contractor to IWR.
- The comments and responses become part of the report and the public record.

# Communications

- NETS web site launched in January 2005.
- NETS NEWS!
  - An email alert with summary information about new developments will go out to team members and other interested parties. The email will provide a link to the product on the NETS web site.
- Presentation to interested groups

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*Developing State-of-the-Art Tools and Techniques for Economic Modeling & Analyses to Help Meet Tomorrow's Navigation Challenges*

The U.S. Army Corps of Engineers is committed to spending the nation's tax dollars wisely by investing in navigation projects that provide the best value for the dollar long term. The Navigation Economic Technologies (NETS) program supports this mission by developing independently-verified economic models, tools and techniques.

Our web site is designed to provide the latest information on the NETS team, the issues we are addressing, the approaches we are using and the status of our activities. The NETS bookshelf contains final reports and policy guidelines, while the toolbox holds final instruments, models, etc. that result from our research. For regular updates on our progress, sign-up for ***NETS News***, a monthly e-newsletter delivered directly to your inbox.

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# Future of NETS

## Summary of additional funding requested for FY09:

- **Item 1.** This is a request for additional funding to conduct event studies. The original work plan included the analysis of real-time planned and unplanned waterway service interruptions as they occurred. The studies completed at Greenup, McAlpine and Lock & Dam 27 have provided invaluable understanding on the types of industry response to these events and the economic impact to the industry and the nation. Each year the system seems to be having greater problems maintaining service and it is important to document the consequences of these service interruptions to better justify future investments in O&M, major rehab and new construction studies.

# Future of NETS

## Summary of additional funding requested for FY09:

**Item 4**. This item funds the extension of the spatial equilibrium forecasting techniques to additional commodity groups (petroleum, containers and coal). This will provide the Corps the ability to forecast marine traffic in a manner consistent with the recommendations of the NAS. This item also provides funds for additional work on the Regional Routing model (RRM) necessitated by unforeseen complications in model development. The RRM will allow Corps planners to relate the global commodity forecast to traffic through a specific lock and give Corps planners an understand the impact of navigation improvements on the alternative modes. This item also includes funding for independent peer review of critical products needed for model certification.

# Future of NETS

Summary of additional funding requested for FY09:

- **Item 5. This item funds the modification of the NETS models to produce estimates of air emissions by river and port segment. This will give the Corps for the first time the ability to directly and robustly estimate the impact Corps projects have on air emission. The systematic quantification of air emissions impacts was one of the original visions for the NETS program and remains a very high priority for our navigation industry partners, but has needed to wait until the appropriate models and estimating techniques were developed.**